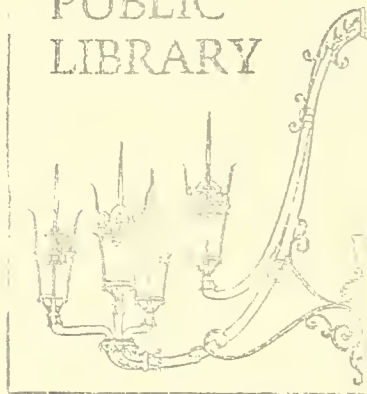


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Prepared for the
61st Annual Meeting of the Transportation
Research Board

January 1982

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CBD Retail Sales; A Case Study

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B.D.

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ABSTRACT

This paper examines the influence that parking has on retail sales in the Central Business District (CBD). A brief review of the literature is provided which cites both case studies of situations in which either the supply or price of parking in the CBD have changed and modelling efforts in which the influence of parking is estimated using multivariate analysis of disaggregate data on shoppers.

The paper then focusses on the specific case of the CBD of Boston, Massachusetts using data from the Census of Retail Trade, parking inventories, parking utilization counts, surveys of parkers in the CBD and surveys of shoppers in the primary retail area of the CBD. The paper examines the extent to which auto users contribute to sales in the CBD, the characteristics of the auto user and the characteristics of the auto users trip to the CBD. The socioeconomic characteristics of the auto user are compared to those of shoppers in the Boston CBD who arrive by transit and their relative contributions to CBD retail sales are examined.

Various relationships between retail behavior and parking characteristics (location, price, walk distance) are examined and reported. The paper concludes with a presentation of the results of a parking location choice model which explains the role of walking distance and price in the determination of parking location.

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1.0 Introduction

This paper presents the results of a one year study of the influence of parking on retail sales in the Central Business District (CBD) of Boston, Massachusetts. The research was conducted by the Center for Transportation Studies of the Massachusetts Institute of Technology under the sponsorship of the Boston Redevelopment Authority (BRA). The research relies extensively on data collected by the BRA as part of an evaluation of the Downtown Crossing, a U.S. Department of Transportation sponsored demonstration project in auto restriction. The Downtown Crossing is the main retail center of Boston and is located in the heart of the CBD. Surveys of parkers returning to their cars during the midday (10 a.m. to 4 p.m.) provide the principal data for the analysis. The parking locations surveyed were located throughout the CBD and many generalizations can be made about the CBD but the focus of the survey and of this analysis was on the influence of parking on retail sales in the Downtown Crossing.

The history of retailing in the Boston CBD is not unlike that in many cities throughout the U.S. Changing travel patterns over the past 30 years coupled with significant shifts in residential location have produced dramatic changes in the role of the Central Business District as a regional retail center. As in most large U.S. cities, increases in the use of the automobile and rapid growth of the suburban areas have changed the CBD from the only truly regional shopping area to one of only many. The question arises, "To what extent should the CBD compete with the other centers for the auto-oriented shoppers?" The cost of providing parking in the CBD far exceeds the cost at the suburban locations, and so that parking must either be offered to the potential customer at a much higher price or it must be heavily subsidized by the City, other governmental agencies or by the retail establishments themselves.

In Boston as in most major U.S. cities, there is constant pressure by the retail community for expansion of the CBD parking supply. However, the land available for parking, if any exists, is often at the periphery of the CBD and at some distance from the retail core. The question of how far people are willing to walk between parking location and shopping destination naturally arises.

This paper explores the influence of parking on retail sales in the CBD by examining the characteristics of the current users of parking spaces in Boston during the midday. The analysis purposely avoids a discussion of the long-term parker, who is using a CBD parking space primarily for the purpose of going to and from work, and concentrates instead on those parkers that may be using the spaces while involved in retail activity in the CBD.

The major research questions addressed in this study are:

1. Who are the people using the CBD parking spaces during the midday?
 - What are their characteristics (age, sex, income, etc)?
 - Where do they live?
 - Are they employed? If so, where?
2. What are the characteristics of the parkers' trips to the CBD?
 - Why are they in the CBD?
 - Where do they park?
 - Where do they go once they have parked?
 - How far do they park from the place or places they visit?
 - How much do they pay for parking?
 - Do they have trouble finding parking?
3. What characterizes the retail activity in which the person parking is involved?
 - How many visit the Downtown Crossing?
 - How many visit other shopping areas?

- How much money is spent in the Downtown Crossing?
- How much money is spent in other areas?

Section 2 of this report describes the results of other research efforts in which the role of CBD parking supply in retail economy has been studied. The review cites both empirical studies which estimate the impacts that actual changes in the parking supply or parking price have produced, and theoretical studies which use various travel and retail models to predict the impacts that would be produced by certain changes in parking supply, location or price.

In Section 3, an overall profile of the midday parker in Boston and his or her trip while in the CBD is presented. The profile is presented in three sections:

- Socioeconomic characteristics of the parker
- Characteristics of the trip
- Characteristics of the parker's shopping activity.

The presentation of the overall profile is followed in Section 4 by a comparison of the characteristics of the Downtown Crossing Shopper who comes downtown by auto with the characteristics of the Downtown Crossing shopper who comes downtown by transit.

Section 5 presents the results of a model of CBD parking location choice that was estimated as part of this analysis. The model results provide insights into the role that parking price and walking distance play in determining where a person will choose to park given a decision has been made to shop in the CBD.

The final section of this study, Section 6, presents the major conclusions of the research effort.

2.0 Literature Review

A review of relevant parking related literature corroborated the need for additional research in the area of economic impacts of parking supply location and pricing policy in the CBD. Research in this area has been limited largely by the lack of high quality data which includes information about the characteristics of the trip maker, characteristics of the travel patterns and characteristics of the traveller's retail activity all together.

Recent research relating to parking impacts has been primarily limited to either attempts to draw conclusions, on the basis of limited empirical evidence, from cases in which actual changes in supply, location or pricing have occurred, or theoretical research efforts to model retail competition between the CBD and other shopping areas in which parking supply was one of many measures of retail site characteristics.

2.1 Empirical Studies*

In 1972, a three-day strike in Pittsburgh eliminated virtually all parking spaces in the CBD. A survey of business owners indicated that retail sales declined by 6 to 7 percent during the strike with substantially greater declines in stores heavily patronized by auto drivers (Hoel and Roszner, 1972). These results must be viewed as only short-term impacts, however, because many purchases may be simply postponed during such a constriction of supply. It is difficult to judge from this experience what the longer term impacts might have been if the parking supply had been permanently reduced.

*The review of empirical studies of the impacts of parking policies was greatly assisted by the following literature review: Karash, Karla, "Parking Strategies: A Review of Current Experience" Massachusetts Institute of Technology, project working paper, Cambridge, MA (July, 1980)

In 1970, a parking tax was levied in San Francisco which increased the cost of parking by 25 percent. Two years later, the tax was lowered to 10 percent. An analysis of the demand response to the tax indicated that the elasticity with respect to price was -0.2 in the first year and -0.3 in the second year (Kulash, 1974). The analysis indicated that the tax not only tended to decrease the number of parkers but also resulted in a decrease in the average time parked. Elasticities of parking revenue were also estimated and were -1.4 in the first year and -1.6 in the second year, reflecting an overall loss of both parkers and parking revenue as a result of the tax. Analysis of department store sales, however, reflected no appreciable change as a result of the parking tax.

2.2 Models of Shopping Center Competition

The most rigorous effort to determine the relative role of parking supply in determining the competitive standing of shopping areas in a region was conducted as a University Research project under the sponsorship of the U.S. Department of Transportation (See Kern, Lerman, Parcells and Wolfe, 1980). The research effort, conducted jointly by the State University of New York at Binghamton and the Massachusetts Institute of Technology, included the estimation of joint destination and mode choice for regional shopping trips in the Boston Metropolitan area. The model considered only shopping trips for "higher order" goods and excluded shopping trips for groceries and convenience items. Several alternative specifications of the model were tried, only one of which included a measure of parking supply as a determinant of shopping center attraction. On the basis of that model, an elasticity of shopping trips to the CBD with respect to parking supply (number of CBD parking spaces) can be estimated. According to the 1977 Census of Retailing,

there were 369 stores in the Boston CBD selling "higher order" shopping goods which captured 11.7 percent of the SMSA retail trade. Our analysis of parking supply indicated that there were roughly 4000 spaces available for shoppers (based on occupancies at 10 AM on an average weekday in 1980). The resulting elasticities using these figures is 0.1, indicating that a 1 percent increase in the number of parking spaces would produce a 0.1 percent increase in the number of shopping trips to the CBD, all else being equal.

Two primary factors limit the use of the elasticity developed from the SUNY-MIT model. The primary limiting factor is the sample size on which the model was based. The model was based on only 171 observations. The second limiting factor is the absence of any measure of either the location of the parking supply or the price of that parking. Obviously adding 100 spaces within 500 feet of the heart of the Downtown Crossing would have a significantly different impact on retail sales than adding those same spaces at South Station.

One recent study which addressed the issue of the location of parking concluded that a change in parking supply which resulted in an increase in average walking time of 2.5 minutes would produce a 29.8 percent decrease in retail sales for the Denver, Colorado, CBD (Kern and Lerman, 1978). That same study indicated that a change of 5 minutes in the average walking time would result in a decrease of 42.6 percent in the CBD retail sales.

This was based on a series of disaggregate travel models and econometric models estimated in other cities but applied in Denver, Colorado, for the analysis of the economic impact of transportation control strategies to reduce air pollution emissions. The reductions in retail sales predicted by the models included not only the reaction of shoppers to the increase in walk distance but also several subsequent reactions. It was hypothesized that the decrease in

sales due to the increase in walk time would result in a reduction in sales employees by the CBD stores. The reduction in employees would then have two additional impacts. The employees were hypothesized to have been making shopping trips in the CBD also, and the reduction in CBD sales employees would make the CBD a less attractive alternative for shopping in the region.

Competing shopping centers would, therefore, gain trips as a result. This series of impacts is obviously also iterative and the model system used in the study was applied iteratively until certain convergence criteria were reached. The initial impact of the change in walking time, not including any change in retail employment, was predicted to be 5.5 percent reduction for a 2.5 minute walking time increase and a 9.9 percent reduction for a 5.0 minute walking time increase.

3.0 Profile of the Midday CBD Parker and Characteristics of the CBD Trip

In developing a profile of the CBD parker and his or her trip, two categories of parkers were identified, those who indicated that at least one business establishment was visited in downtown Boston and those who did not list any establishments. Because the focus of this study was primarily on the use of parking spaces for retail activity, the analysis is almost exclusively limited to the group which indicated that at least one establishment was visited. The relative numbers of survey responses in each of the two groups are illustrated below

	<u>WITH VISITS</u>	<u>WITHOUT VISITS</u>	<u>TOTAL</u>
1978	430	218	648
1980	314	192	516
COMBINED	744	410	1154

3.1 Socioeconomic Characteristics of the Parker

Table 1a illustrates the socioeconomic characteristics of the parker in the survey. The survey indicates that among those respondents giving the destination(s) of their trips, there are more men than women (61.8% compared to 38.2%), the household income is high (48.9% have household incomes of \$30,000 or more in 1980 dollars and 79.2% have an income of \$18,000 or more). While the ages of the respondents are distributed fairly evenly between the ages of 25 and 64 (84.1%), the highest concentration is in the age group between 25 and 35 (28.7%). A majority of the respondents reside outside of Boston (79.6%) and primarily in the outer suburbs* (59.5%).

*"Outer Suburbs" is defined to include all communities in Eastern Massachusetts other than Boston, Brookline, Cambridge, Somerville and Watertown.

TABLE 1a

CHARACTERISTICS OF THE MIDDAY CBD PARKERSOCIOECONOMIC CHARACTERISTICSPARKING LOCATION USER SURVEY 1978 AND 1980

<u>AGE</u>		<u>CITY OR TOWN OF RESIDENCE</u>	
under 16	0.0%	Boston	20.4%
16 to 24	9.3	Inner Suburbs	6.0
25 to 34	28.7	Outer Suburbs	59.5
35 to 44	19.5	Out of Eastern Mass.	14.1
45 to 64	35.9		<u>100.0%</u>
65 or over	<u>6.6</u>		
	100.0%		
		<u>EMPLOYED</u>	
<u>SEX</u>		Yes	80.4%
Male	61.8%	No	<u>19.6</u>
Female	<u>38.2%</u>		<u>100.0%</u>
	100.0%	<u>CITY OR TOWN OF EMPLOYMENT</u>	
<u>INCOME</u>		Boston	41.0%
Less than \$6,000	2.0%	Inner Suburbs	8.0
\$6,000 - 11,999	6.6	Outer Suburbs	38.7
\$12,000 - 17,999	12.1	Out of Eastern Mass.	12.3
\$18,000 - 29,999	30.3		<u>100.0%</u>
\$30,000 or more	<u>49.0</u>		
	100.0%		

While most of the respondents in the sample were employed (80.4%) only 41% were employed in Boston. A significant percentage of the sample were employed in the outer suburbs (38.7%).

3.2 Characteristics of the CBD Trip

A profile of the trips made by the parkers in the survey is provided by the statistics in Table 1b.

Trip Purpose

For the parkers in the sample, 53.3% of the trips were for purposes other than work or work related business. An additional 8.3% were for work and at least one other purpose. Only 38.3% were exclusively for work or work related business.

Time Parked

The time parked for the survey participants was relatively short term. The average time parked was 3.2 hours^{*} and 69% of the respondents were parked for 3 hours or less. The short term nature of the parking is not surprising, however, due to the nature of the survey. Because only parkers leaving before 4 PM were surveyed, the time parked by survey respondents will naturally be less than the overall average for CBD parkers.

Auto Occupancy

Of the respondents surveyed, 48.3% were the only person in the vehicle and 84.7% reported 2 or less occupants.

* It should be noted that averages reported in this analysis are often higher than median values because of several very high numbers reported by respondents. For example, parking times as large as 96 hours were reported.

TABLE 1b

CHARACTERISTICS OF THE MIDDAY CBD PARKER

TRIP CHARACTERISTICSPARKING LOCATION USER SURVEY 1978 AND 1980

<u>Trip Purpose</u>		<u>Cost of Parking</u>	
Work Related Only	38.3%	\$0.00	16.4%
Work and Personal	8.2	\$0.01 to .99	7.3
Work and Other	0.2	\$1.00 to 1.99	21.5
Personal Only	45.2	\$2.00 to 3.99	14.5
Personal and Other	2.7	\$4.00 to 5.99	5.1
Other	5.4	\$6.00 or more	100.0%
		Average Cost - \$2.37	
<u>Time Parked</u>		<u>Cost Per Hour of Parking</u>	
Less than 1 hour	23.7	\$0.00	16.4%
1.01 to 2 hours	25.0	\$.50/hr. or less	14.5
2.01 to 3 hours	20.3	\$51/hr.- .75/hr.	20.9
3.01 to 5 hours	18.2	\$.76/hr.- 1.00/hr	21.3
More than 5 hours	12.8	more than \$1.00/hr.	26.9
	100.0%		100.0%
Average Time Parked - 3.2 hours		Average Cost per Hour - \$.94	
<u>Auto Occupancy</u>		<u>Trouble Finding Parking</u>	
1	48.3%	Yes	22.6%
2	36.4	No	77.4%
3	9.4		100.0%
4+	5.9		
	100.0%		
Average Auto Occupancy - 1.7			

Cost of Parking

While the average cost of parking for the survey sample might appear low (\$2.37), this average reflects a significant number of onstreet parkers in illegal spaces in the sample (16.4%) who recorded no cost. If this group is removed from the sample, the average cost is \$2.83.

Likewise the cost per hour of parking appears relatively low (average - \$0.94/hour) but if those not paying a parking charge are removed from the sample, the resulting average is \$1.12/hour.

Trouble Finding Parking

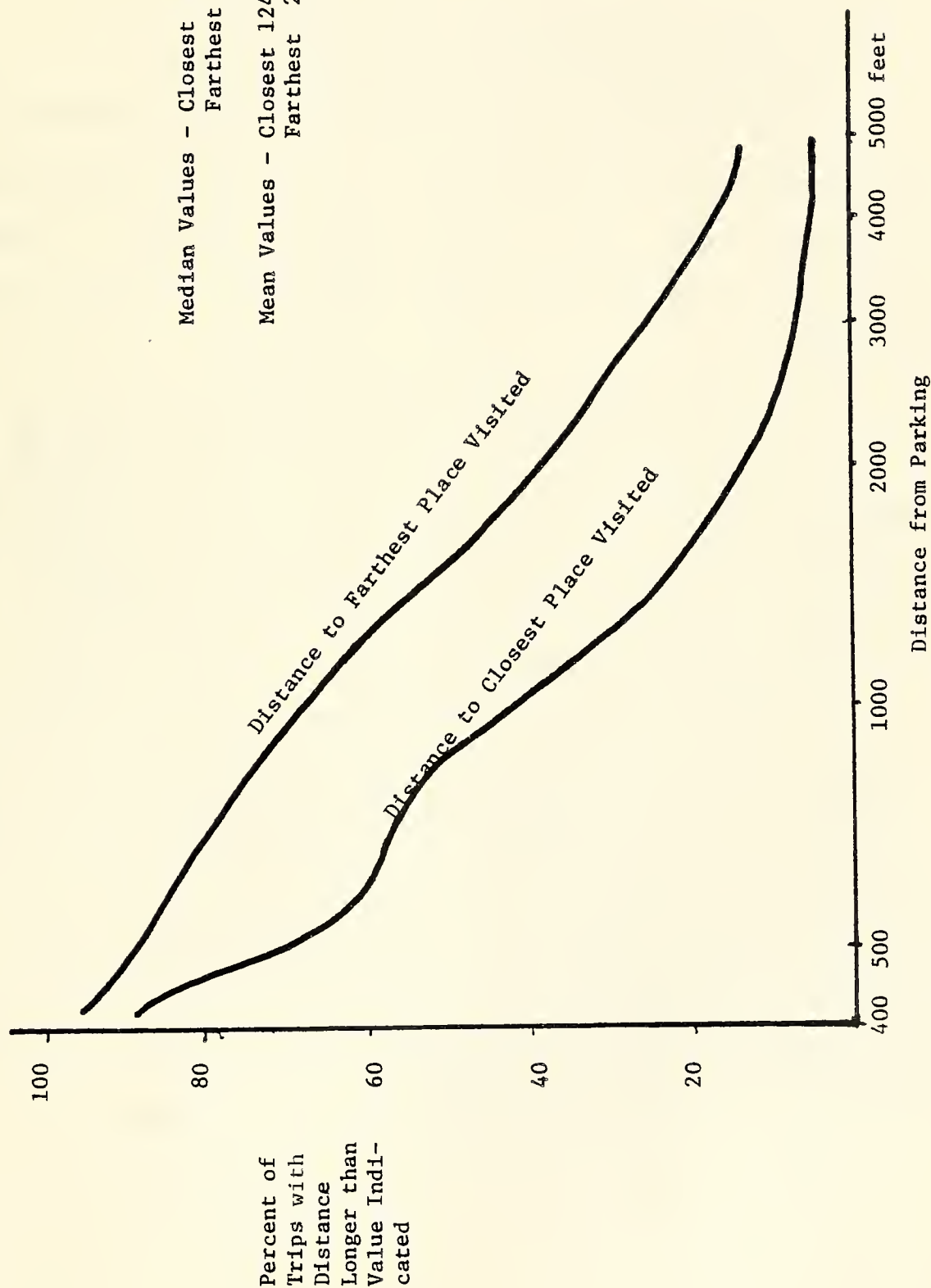
When respondents were asked if any trouble was encountered in finding a parking space, 77.4% said "no". While this might appear to contradict the conventional wisdom about parking availability in the Boston CBD, it is certainly consistent with our analysis of surplus parking. It should also be recognized that because 41 percent of the respondents were employed in Boston and because only people who had found spaces were surveyed, this statistic may be artificially high. It might well be the case that those who perceive parking in the Boston CBD as difficult chose not to drive to the CBD.

Distance from Parking to Places Visited

Figure 1 illustrates the distribution of distances from parking places to places visited. The cumulative frequencies of the maximum and minimum distance are illustrated. Fifty percent of the respondents parked within 900 feet of their nearest destination, but the median distance from the farthest destination is 1525 feet. While the median distances are relatively low (maximum - 1500 feet, minimum - 900 feet), the presence of very large distances in the data set produce mean values significantly higher than the median distances. The mean distance to the closest place visited was 1246 feet, and the mean distance

Figure 1

DISTRIBUTION OF DISTANCE FROM PARKING PLACE TO PLACES VISITED
PARKING LOCATION USER SURVEY 1978 AND 1980



to the farthest place visited was 2388 feet. To provide some perspective, the Boston Common Garage is roughly 2000 feet from the heart of the Downtown Crossing (the intersection of Winter and Washington Streets).

3.3 Shopping Characteristics

Establishments Visited in the Downtown Crossing

Among the respondents from the parking locations convenient to the Downtown Crossing who indicated that at least one place was visited in the CBD, 86 percent visited at least one place in the Downtown Crossing. Of those visiting places in the Downtown Crossing, roughly half (46.4%) visited more than one place.

Value of Purchases in the Downtown Crossing

The average value of a purchase in the Downtown Crossing when a purchase was made was \$77.38 but almost half of the purchases (46.2%) were for \$25.00 or less. This again reflects the presence of some high purchase values in the sample. The maximum purchase value recorded was \$1200.

Total Value of Purchases in the CBD

Neither the distribution of total CBD purchases nor the average value is significantly different than the corresponding statistics for purchases in the Downtown Crossing. The average total value of purchases in the CBD was \$80.94, and 44.1 percent of the purchases were for \$25.00 or less. When those respondents visiting establishments in the CBD but not making purchases were considered, the average purchase per parker was \$47.84. In comparison, the average parking charge for those paying for parking (\$2.83) is only about 6 percent of the average purchase value.

TABLE 1c
CHARACTERISTICS OF THE MIDDAY CBD PARKER
SHOPPING CHARACTERISTICS
PARKING LOCATION USER SURVEY 1978 AND 1980

<u>Establishments Visited in the Downtown Crossing*</u>		<u>Total Value of Purchases in the CBD *</u>	
0	14.0		
1	46.1	\$0.001-10.00	19.3%
2	16.1	10.01-25.00	24.8
3 or more	23.8	25.01-50.00	19.6
	<u>100.0%</u>	50.01-100.00	15.0
		over \$100.00	21.3
			<u>100.0%</u>
<u>Value of Purchases in the Downtown Crossing *</u>		Average value of purchases in the CBD = \$80.94	
0.01-10.00	21.8%		
10.01-25.00	24.4		
25.01-50.00	16.7		
50.01-100.00	15.3		
over \$100.00	21.8		
	<u>100.0%</u>		
Average value of purchase in the Downtown Crossing= \$77.38			

* Prudential Center and Quincy Market parking locations are excluded.

3.4 Distance from Parking to Places Visited

On the hypothesis that there might be a correlation between the distance that a person travels between the place of parking and the places visited in CBD and certain characteristics of either the parker or the trip, each of the socioeconomic characteristics, trip characteristics and shopping characteristics were examined with the sample stratified by distance to farthest place visited. The stratification used was "2000 feet or less" and "more than 2000 feet". No discernible differences could be identified between the two groups on the basis of any of the socioeconomic characteristics.

In examining the relationship between the distance from parking to place visited and the characteristics of the shopping trip two hypotheses were tested:

1. The distance from parking to farthest place visited should increase as the number of places visited increases.
2. The total value of purchases in the CBD should increase as the distance from the farthest place visited increases. If the first hypothesis is correct, then longer distances should be correlated with more places visited and thus higher value of purchases made.

To evaluate the relationship between number of places visited and the distance to farthest place visited only those respondents visiting at least one Downtown Crossing establishment were examined. A group consisting of those respondents visiting two or more establishments was compared to the group as a whole. The results are presented in Table 2.

There is clearly a difference in the distribution of distance to farthest place visited with the group with two or more places visited having significantly longer distances.

To test the second hypothesis, the full sample of respondents with CBD visits was again used and the distribution of total value of CBD purchases were compared for three stratifications of distance to farthest place visited.

TABLE 2

COMPARISON OF DISTANCE FROM PARKING TO FARTHEST PLACE VISITED BY NUMBER OF PLACES VISITED - PARKING LOCATION USER SURVEY 1978 AND 1980

Distance to Farthest Place Visited	All Respondents Visiting the Downtown Crossing	Respondents Visiting Two or More Places in the Downtown Crossing
500 or less	6.9%	2.9%
501 ft. to 1000 ft.	16.3	7.5%
1001 ft. to 1500 ft.	27.0	25.7
1501 ft. to 2000 ft.	16.4	17.5
2001 ft. to 3000 ft.	12.9	14.3
Over 3000 ft.	<u>20.6</u> 100.0%	<u>32.2</u> 100.0%

*Comparison of the distributions of the two groups indicates a significant difference at the 99% confidence level based on χ^2 test.

TABLE 3

COMPARISON OF TOTAL VALUE OF PURCHASE IN THE CBD BY DISTANCE TO FARTHEST PLACE VISITED - PARKING LOCATION USER SURVEY 1978 AND 1980

Total Value of Purchases	DISTANCE TO FARTHEST PLACE VISITED		
	1000 ft. or less	1001 to 2000 ft.	Over 2000 ft.
Zero	44.6%	38.1%	29.9%
\$0.0. to 10.00	13.8	8.8	12.8
\$10.01 to 25.00	11.1	17.9	14.3
\$25.01 to 50.00	11.4	10.0	14.1
\$50.01 to 100.00	8.3	13.8	12.1
over \$100.00	<u>10.8</u> 100.0%	<u>11.4</u> 100.0%	<u>16.8</u> 100.0%

*Comparison of the distributions of the three groups indicates a significant difference at the 99% confidence level based on χ^2 test.

That comparison is illustrated in Table 3. Again there appears to be an increase in the total value of purchases as the distance increases, although the trend is relatively weak.

4.0 Comparison of Parkers and Transit Patrons in the Downtown Crossing

When assessing the role of parking in determining the retail economy of the CBD, comparisons between CBD shoppers that have driven to the area and those that have arrived by transit are naturally of interest. The comparison which is presented in this report is based on a survey of pedestrians in the Downtown Crossing in June of 1980.

Table 4 presents a profile of the socioeconomic characteristics of the two types of Downtown Crossing patrons and a few characteristics of their trips.

The following points arise from the comparisons:

- Transit users are generally younger (37.9% are under the age of 25 compared to 21.3% for auto users).
- Auto users are generally from higher income households (65.3% have household incomes of \$18,000 or more compared to 34.9% for transit users).
- A higher percentage of transit users reside in Boston (50.9% compared to 24.9% for auto users).
- When purchases are made, the median purchase value is higher for auto users than for transit users (\$46.56 for auto users compared to \$25.80 for transit users).

This comparison illustrates the importance of parking in attracting certain types of retail customers (higher income and suburban residents) and also illustrates the importance of those customers that are attracted to come to the CBD by automobile (an average purchase value of almost twice the average for transit users). An assessment of the role of parking in determining the retail economy of the CBD must also consider the relative contribution of the customers that arrive by automobile. Because about 30 percent of the midday shoppers in the Downtown Crossing have come downtown by automobile, the total contribution to retail sales in the Downtown Crossing could be as much as

TABLE 4

COMPARISON OF TRANSIT USERS AND AUTO USERS IN THE DOWNTOWN CROSSING

PEDESTRIAN SURVEY - 1980 *

	<u>Transit Users</u>	<u>Auto Users</u>	<u>City or Town of Residence</u>	<u>Transit Users</u>	<u>Auto Users</u>
<u>Age</u>					
under 16	3.3%	0.0%	Boston	50.9%	24.9%
16 to 24	34.5	21.3	Inner Suburb	14.8	6.0
25 to 34	22.0	19.1	Outer Suburb	31.2	52.8
35 to 44	8.7	25.8	Out of Eastern Mass.	3.1	16.3
45 to 64	18.0	16.8		100.0%	100.0%
65 or over	13.5	17.0			
	100.0%	100.0%			
<u>Sex</u>			<u>City or Town of Employment (if Employed)</u>		
Male	39.9%	44.7%	Boston	67.8%	72.4%
Female	60.1	55.3	Inner Suburbs	19.7	6.6
	100.0%	100.0%	Outer Suburbs	12.4	11.1
			Out of Eastern Mass.	0.1	9.9
				100.0%	100.0%
<u>Household Income</u>					
Less than \$6,000	23.4%	6.0%	<u>Value of Purchases in the</u>		
\$6,000 - 11,999	15.0	9.3	<u>Downtown Crossing</u>		
\$12,000-17,999	26.8	19.4	Mean Value	\$25.80	\$46.56
\$18,000-29,999	20.7	42.4	<u>Frequency of Travel to the</u>		
\$30,000 or more	14.1	22.9	<u>Downtown Crossing</u>		
	100.0%	100.1%	Mean Value (Trips/Mo.)	8.3	7.2

*All comparisons between groups indicate significant differences at the 99% confidence level using either χ^2 or difference of means test where appropriate.

40 to 45 percent. However many of these midday shoppers are employees in the CBD who drive to work but who walk from work to the Downtown Crossing to shop. As is illustrated in Table 5, only about 7.1 percent of the shoppers in Downtown Crossing drive directly to the CBD to shop but because of the higher purchase value per customer, this 7.1 percent represents 13.7 percent of the purchases in the Downtown Crossing.

TABLE 5
RELATIVE CONTRIBUTIONS TO CBD SALES

	Percent of Downtown Crossing Visitors	Percent of Downtown Crossing Sales
CBD Employees	41.8	37.8
Other Shoppers		
Auto Users	7.1	13.7
Transit Users	36.6	37.0
Walkers	12.0	10.8
Others	2.5	1.0

5.0 Price and Walking Distance as Determinants of Parking Location Choice

The apparent relationship of distance from farthest place visited and both time parked and cost per hour of parking identified in the previous section suggests that there is a tendency for the more convenient parking locations to be priced higher on a cost per hour basis and that the parker is considering this factor when choosing a parking location. Those that are planning to park longer tend to choose the lower priced but less convenient places.

To more closely examine the role of distance from parking and parking cost in determining parking location, a statistical model of parking location was developed which estimated the probability that a parker would choose one of five parking locations on the basis of the cost associated with parking at the specific location and the distance from the location to the place (or places) visited. The model was estimated using only respondents from the 1978 survey and only those who indicated that at least one establishment had been visited in the Washington Street area (what is now the Downtown Crossing). A total of 220 respondents were included in the sample.

The model, which was a multinomial logit type, distributed trips between the five parking areas but did not predict changes in overall demand for trips to the area that would be produced by changes in parking location, price or supply. Each decision-maker (i) in the observation data set was assumed to have made a choice of parking location j from a set of five alternative locations. The utility to the individual of any alternative is hypothesized to be a linear function of the attributes of the alternative (X_{ij}) as perceived by the individual.

$$U_{ij} = \sum_{k=1}^K \beta_K X_{ijk}$$

where

x_{ijk} = k^{th} attribute of alternative j for decision maker i .

β_k = a coefficient representing the contribution of the k^{th} attribute to utility

It is further postulated that the probability of i choosing alternative j can be expressed as:

$$P_i(j) = \frac{e^{U_{ij}}}{\sum_{j=1}^5 e^{U_{ij}}}$$

The utility function for each alternative was specified as follows:

$$U_{ij} = \beta_{j1} + \ln(\text{CAP}) + \beta_2 \text{ TIME} + \beta_3 \text{ COST}$$

where

β_{j1} = An alternative specific constant estimated for all but one alternative.

CAP = The capacity of the location at 10 a.m.

TIME = Round trip walking time between the parking location and the respondents destination.

COST = Parking charge for the respondent at alternative given the reported time parked.

The term $\ln(\text{CAP})$ was included to control for a size bias produced by the aggregation of the 10 lots and garages into 5 major groups.

The results of the model estimation were as follows:

<u>Variable</u>	<u>Coefficient Value</u>	<u>t-statistic</u>
TIME	-.0015	-6.15
COST	-.0081	-3.94

$$L(0) = -352.5$$

$$L(B) = -300.7$$

$$L(C) = -330.4$$

Number of Observations = 220

Alternative specific constants ranged from 0 to 1.46 but only the constant term for one location proved to be a significant factor in the model. The significant constant term was for the Boston Common Garage, a large garage located beneath the Boston Common and adjacent to the Downtown Crossing.

The sign of both TIME and COST are intuitively correct and significantly different than zero at the 99 percent confidence level. Log-likelihood ratio tests also indicated that the model estimated is significantly better in explaining the observed choice behavior than either the naive choice model in which all coefficients are zero or the model in which only the alternative specific constants may take on nonzero values.

The model results indicated that both distance and cost are important determinants of parking location choice and that there is a trade off between walking time and price paid of about 25¢ per minute of walking time. This indicates that the typical parker would be willing to pay 25¢ in the total cost of parking (not the cost per hour) for each minute of round trip walking time saved.

The model results also indicated that for the present conditions, as represented by the sample of respondents used in the model estimation, the

parking location choice is slightly more sensitive to walk distance than to the cost of parking. The elasticity of demand with respect to walking distance was estimated to be -2.1 while the elasticity with respect to cost of parking was -1.4.*

As an illustration of the meaning of the elasticities, consider the Boston Common Garage which captured roughly 20% of the trips in the sample. If the location of the garage was changed such that the average walk distance was reduced by 20% (roughly 250 feet) the model would predict an increase in the share of parking trips going to the garage of $20 \times 2.1 = 42\%$. (Note that this predicted increase is only for those going downtown who visit at least one establishment.) The new share for the garage would then be $20 \times 1.42 = 28.4\%$.

South Station location meaning - Transstate

*Elasticities were estimated for a parking location capturing 20% of the trips and using the average walk distance for the sample of 1728 feet and the average price paid of \$2.21.

6.0 Summary of Conclusions

Parking availability is often viewed as a necessary condition for a healthy, active retail center. It is undeniable that suburban shopping centers with little or no transit service would not survive without substantial amounts of parking. But what about what is often the largest retail center in the city, the Central Business District? To what extent is its retail vitality dependent on the shopper who requires a parking space?

While this analysis of the midday parker/shopper in the Boston CBD has not provided a definite answer to this question, the research effort has yielded considerable insight into the characteristics of the CBD parker/shopper in Boston and the characteristics of his or her trip. The remainder of this section is devoted to a summary of those insights.

Availability of Parking for Shoppers

There is strong evidence that there is a surplus of parking in the Boston CBD during the midday. Parking accumulation counts indicate that at least 20 percent, and probably as much as 30 percent, of the total offstreet parking capacity is available at 10 AM on an average weekday. Many of these spaces are in garages and rates may be as high as \$2.50 per hour, but spaces were generally found to be available in locations convenient to the retailing in the CBD. The availability of parking for shopping is generally supported by the fact that 77.4 percent of those surveyed said they did not have any difficulty finding a space.

Characteristics of the Midday Parker/Shopper

Among those parkers who were surveyed and who visited at least one business establishment in the CBD, most lived outside of the city of Boston (79.6%) and a significant number (14.1%) lived outside of eastern Massachusetts. Although most respondents were employed (80.4%), only about 41 percent of those

were employed in Boston. Almost half of the respondents (46.7%) gave work or work related business as one reason for being in the CBD.

There were roughly 50 percent more men in the sample than women, but among those respondents who gave work or work related business as the only reason for being in the CBD, there were four times as many men as women. Among those who came to the CBD for non-work purposes, there were roughly equal proportions of men and women.

In a comparison of transit users and auto users shopping in the Downtown Crossing, auto users were found to have a higher household income (65.3 percent had incomes of \$18,000 or more compared to only 34.8 percent for transit users) and a smaller percentage lived in Boston (24.9 percent compared to 50.9 percent among the transit users).

Trip Characteristics

The average time parked among the survey respondents was 3.2 hours but 69 percent of the respondents were parked for 3 hours or less. The average parking cost was \$2.37 and the average cost per hour of parking was \$0.94 when the full sample is used. If those respondents parked in illegal onstreet spaces for which no parking fee was paid (about 16% of the sample) are excluded, the average parking cost increases to \$2.83 and the cost per hour increases to \$1.12. While the average time parked and the average cost of parking were both lower for those in the CBD for shopping than those in the CBD for work, the average cost per hour of parking was virtually the same (shopping - \$0.89/hour, work - \$0.92/hour).

Fifty percent of those surveyed parked within 900 feet, or roughly a 3-1/2 minute walk, of at least one place visited. Ninety percent parked within 2100 feet or about an 8-minute walk. The median distance from parking

to the farthest place visited was 1500 feet or roughly a 5-1/2 minute walk. The average distance from parking to the closest place visited varied only slightly by trip purpose but varied significantly by parking location. The shortest average distance to places visited was recorded among parkers in the Downtown Crossing Lots (718 feet to closest place visited).

Shopping Characteristics

The average value of purchases made by respondents when purchases were made was \$80.94. Among all respondents visiting business establishments in the CBD, the average value of purchases was \$47.84 (considering parkers visiting businesses but not making purchases).

The average vehicle occupancy in the sample was 1.74 and so the average value of expenditures divided by the average occupancy is roughly \$27.00. Among shoppers interviewed in the Downtown Crossing, people who had travelled downtown by auto had a higher value of purchase when a purchase was made (\$46.54) than did people who had travelled downtown by transit (\$25.80). Among shoppers other than CBD employees, people arriving downtown by car represent only 7.1 percent of the shoppers but 13.7 percent of sales in the Downtown Crossing.

Sensitivity of Retail Sales to Parking Supply, Location and Price

On the basis of other research efforts, there is an indication that the elasticity of total demand for shopping trips to the Boston CBD with respect to parking supply is roughly 0.6. A 10 percent increase in parking available to shoppers (at a distance from shopping roughly equivalent to the present locations of parking) should produce roughly a 6 percent increase in shopping trips to the CBD.

In choosing a parking location in the CBD, individuals are willing to pay roughly 25¢ for each minute of round-trip walking time from parking that is saved. When considering the distribution of parking among CBD parking spaces (the total number of auto trips to the CBD held fixed), the elasticity

of demand with respect to walking distance from destination for a specific location is roughly -2.1. For the average walk distance of 1721 ft.*, a 100 ft. increase in the walking distance would result in 12.2% decrease in the location's share of the total number of parkers. The elasticity of demand with respect to parking cost is roughly -1.4. For the average parking cost of \$2.37*, a \$0.50 increase in the average cost per parker for a particular location would produce roughly a 29.5% decrease in the location's share of the CBD parker.

* Average for parkers in 1978 visiting locations in the Downtown Crossing.

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